Statutory Bases for Rejections

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

New Art Rejections

Ohara in view of Jones

Claims 1, 2, 3, 8, 10 – 13, 33, 35 – 38, 40 – 41, 44 – 48, 51 – 55, 58, 67 – 70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohara in view of USP 5,112,500 to Jones.

Ohara, et al., “Sludge dewatering studies at the Hyperion Treatment Plant,” Journal WPCF, May 1978, pp. 912 - 925 (hereinafter, “Ohara”), describes dewatering biological sludge from a thermophilic digestion process. Polymers are added to the

digested sludge to improve dewatering (page 917 at middle of left column, Fig. 5, Table III). Ohara states that

> polymers, in general, were more effective for coagulation than the inorganic coagulants [page 914, right column];
>
> combinations of dewatering chemicals were often more effective than single materials (for example, anionic, cationic, or nonionic polymers alone) [page 921, right column, discussion point no. 3]; and
>
> a combination of anionic and cationic polymers worked best [page 914, middle of right column].

Accordingly, Ohara describes the use of “a combination” of an anionic conditioning polymer and a cationic conditioning polymer to enhance dewatering of thermophilically digested biological sludge.

Ohara does not disambiguate whether a “combination” takes the narrower meaning of a physical mixture of different polymers added to the sludge only after being mixed together, or the broader meaning of using two different polymers (irrespective of the physical form or temporal ordering of use) rather than only one polymer. The latter interpretation appears to be a fairer reading of Ohara given Ohara’s use of the terms “single” and “alone” in the phrase, “combinations of dewatering chemicals were often more effective than single materials (for example, anionic, cationic, or nonionic polymers alone)” (page 921, right column, discussion point no. 3). Moreover, there is no discussion of using “mixtures” of different polymers blended together before addition to the sludge suspension.

In any event, Ohara does <u>not</u> describe the chemical structure, formulae, or identity of any of the 41 conditioning polymers tested (page 914). Specifically, as it

relates to the claimed invention, Ohara does not explicitly describe the addition of a "polymeric quaternary ammonium compound" or the addition of a polyacrylamide. It would have been obvious, however, to have selected both a cationic conditioning polymer and an anionic conditioning polymer for use in combination, as taught by Ohara, to enhance sludge dewatering because, as noted above, Ohara states that a combination of anionic and cationic polymers worked best (page 914, middle of right column).

We now direct our attention to the Jones reference. Jones also describes the common prior art practice of sequentially dosing an aqueous solution of a coagulent and an aqueous solution of a bridging flocculent (col 1 line 64+). Jones describes the sequential addition (col 3 line 40) of a cationic polymeric quaternary ammonium coagulant flocculent,[1] e.g., polydiallyldimethyl ammonium chloride, aka, polyDADMAC, e.g., Magnafloc 368 (col 4 lines 20, 63-66 – col 5 line 12, 24 - 29; col 2 line 26, col 6 lines 25 – 27), and an anionic polyacrylamide (col 5 line 30, 34 – 38, 50-58) to enhance dewatering of a sewage sludge (col 7 line 67). Jones also describes (and prefers) the simultaneous addition of a particulate coagulent and a counterionic particulate flocculent as a premixed blend to a sewage sludge (col 3 line 40). In fact, the Jones patent claims are all limited to "adding the selected dosages of the anionic and cationic particulate flocculents substantially simultaneously to the suspension as a premixed blend" (Jones claim 1).

[1] The term, "primary component," as used by applicant / owner in the claims of this application / proceeding, reads on the term "coagulant" or "coagulent flocculent," as used by Jones (col 1line 26+).

In view of Jones, it would have been obvious to have selected cationic polyDADMAC coagulant (i.e., “primary component”) or epi-DMA coagulant (Jones col 5 lines 15 – 20) and an anionic polyacrylamide bridging flocculent for use as the cationic and anionic polymers, respectively, of Ohara’s process for dewatering a thermophilically digested biological sludge. Moreover, at the time the invention was made, it would have been obvious to have added these counterionic polymers – either as particulate beads or as aqueous solutions - to the digested sludge ***separately*** rather than simultaneously as a premixed blend of particulates in order to avoid infringing the Jones patent.

Per claims 10 and 45, Jones describes a lower MW coagulant : higher MW flocculent weight ratio of 10:1, as claimed.

Per claim 11, Jones describes the bridging flocculent polymer as at least 10%, at least 50%, or at least 80% ionic, with the remainder being nonionic (col 5 lines 40 - 45. Accordingly, insofar as Jones has identified percentage ionic character of the bridging flocculent as a known result-effective process parameter, it would have been obvious to have optimized this parameter through routine experimentation.

Per claims 12, 52 Jones describes a preferred weight ratio of the lower MW quaternized coagulant to the higher MW polyacrylamide bridging flocculent of about 10:1 – 1:10 (col 7 lines 4 - 11).

Per claims 13, 37, 40, 46, 53 the dewatering polymer dosage is a known result-effective process parameter, as shown by Jones (Example I, col 8 lines 34 – 47), so optimization of the same through routine experimentation would have been obvious.

Per claim 47 Jones describes the high MW bridging flocculent polymer as having a MW of at least 5 million (col 1 line 18).

Per claims 24, 47, and 54, Jones describes the coagulant polymer having a MW range of 100,000 – 2 million (col 4 lines 22 - 29).

<u>McGrow in view of Ohara</u>

Claims 1 – 7, 15 – 16, 22, 24 – 28, 33, 35 – 37, 41, 44 – 48, 51 – 55, 58, 67 – 70, 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over McGrow in view of Ohara.

USP 5213693 to McGrow describes a method of facilitating the dewatering of a digested activated (i.e., biological) sewage sludge suspension (col 7 line 49) by adding a solution containing both a low molecular weight quaternized coagulant compound, e.g., poly(DADMAC)(col 4 line 37) or a polyamine made by condensation of epichlorohydrin with an amine (col 4 line 29), and a high molecular weight cationic polyacrylamide flocculent (col 5 line 55) to the sewage sludge suspension (Example I). The polymers may be added as a blended solution or as separate solutions added to the suspension "substantially simultaneously" (column 7 lines 10). McGrow teaches that use of the poly(DADMAC) or poly(epichlorohydrin-amine) in addition to the cationic polyacrylamide offers numerous advantages over the traditional methods of using the high molecular weight cationic polymeric flocculent alone (col 6 line 30).

McGrow does not state that the biological sewage sludge to which the polymers are added is a sludge that has been thermophilically digested. Ohara, however, states

that a sludge that had been digested thermophilically dewatered more easily than a sludge that had been digested mesophilically (Ohara, p. 917, left column, last paragraph). Accordingly, it would have been obvious in view of Ohara's teaching to have digested McGrow's sewage at thermophilic conditions rather than at mesophilic conditions before dewatering.

Per claims 5 - 6, 27, 45, 52 McGrow describes a preferred weight ratio of the lower MW quaternized coagulant to the higher MW polyacrylamide flocculent of about 0.7:2 (col 5 line 57-63).

Per claims 7, 28, 37, 46, 53, the dewatering polymer dosage is a known result-effective process parameter, so optimization of the same through routine experimentation would have been obvious.

Per claim 22, "substantially simultaneously," as described in McGrow and discussed above, covers both simultaneous addition of separate solutions of the polymers, as well as addition of one polymer followed soon thereafter by the addition of the other polymer solution.

Per claims 24 and 54, McGrow describes the coagulant polymer having a MW range of 100,000 – 3 million (col 3 line 47).

Per claim 47, McGrow describes the high MW flocculent polymer as having a MW of at least 5 million (col 4 line 47).

<u>Ohara / Jones or McGroww / Ohara in view of Genter or Fordyce</u>

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ohara and Jones, or over McGrow and Ohara, each combination as applied to claim 1 above, further in view of either USP 1999973 to Gentler or USP 3023162 to Fordyce. Genter at Sheet 3 describes mixing a primary sludge (labeled as “raw sludge”) with step “No. 5” which is immediately downstream of the digestion step. Fordyce describes mixing primary sludge with digested sludge (col 5 lines 8 – 9). It would have been obvious to have mixed the biological sludge of either Ohara (as modified by Jones) or McGrow (as modified by Ohara) with primary sludge insofar as such practice was conventional, as shown by Fordyce or Genter.

<u>New Rejection Based on Ohsol</u>

Claims 1, 4 – 8, 10 – 13, 16 are rejected under 35 U.S.C. 102(e) as being anticipated by USP 5593591 to Ohsol.

Ohsol describes a method for dewatering biological sludge (col 1 lines 3, 35 – 43, 45 - 47). The sludge entering the flash vessel 20 comes from a “thermophilic digestion process” because the biological solids in line 14 near the steam injection line 16 are exposed – albeit briefly - to temperatures in the thermophilic range, i.e., well-known in the art to be about 120ºF – 135 ºF,[2] in the course of being heated from a temperature below the thermophilic range (i.e., ambient temperature in the thickener 10) to at least

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[2] See, for example, USP 2315577 to Bach, page 1, right column, lines 30-31.

250ºF (col 6 line 6). During this brief period of time in the thermophilic temperature range, at least some digestion inherently takes place.

At col 6 lines 55 – 56, Ohsol teaches adding a combination of a polyacrylamide flocculent ("homopolymers of acrylamide," col 6 line 51) and "copolymers of acrylamide with other monomers, such as … [a] quaternized-amine containing monomer" (col 6 lines 51 – 55). The point at which the combination of these flocculent polymers is added to the sludge, i.e., line 62 and/or line 64 at B, is downstream of the point at which the temperature transitions through the thermophilic temperature range. Accordingly, Ohsol describes dewatering a biological sludge from a thermophilic digestion process by adding both a polymeric quaternary ammonium compound as well as a cationic polyacrylamide (col 6 line 58 – 60) to the biological sludge.

In an alternative embodiment, Ohsol describes first adding a complexing agent used in combination with quaternary ammonium salts, ***before*** addition of the polyacrylamide flocculents described above (col 7 lines 47 col 8 line 12). Ohsol therefore also describes the addition of anionic polyacrylamide (col 6 lines 58 – 64) separate from the addition of the quaternized ammonium compound.

Among the quaternary ammonium salts described in USP 4,026,870 to Floryan (the entire disclosure of which is incorporated by reference into Ohsol) are trioctylmethylammonium chloride, tetraethyl ammonium chloride, and tetrabutyl ammonium chloride (Floryan, at col 2 lines 32-35).

Per claims 5, 12, Ohsol teaches that the amount of quaternized ammonium compound-containing complexing agent added to the sludge is a result-effective

variable (col 8 lines 9 – 11), so optimization of this process variable is within the level of skill in the art and obvious. The molecular weight of the polyacrylamide flocculent is as high as 5,000,000 (col 7 line 3).

Per claims 6, 7, 12, 13 Ohsol teaches that the amount of flocculent added is a result-effective variable (col 7 lines 38 – 47), so optimization of the floccuent dosage is within the level of skill in the art and obvious.

Per claim 11, Ohsol teaches that the degree of hydrolysis and charge density of the polyacrylamide flocculents is a known result-effective variable, so optimization of the same would have been obvious.

Per claim 16, Ohsol describes addition of solutions of flocculent (col 7 lines 27 – 38)

<u>Previously Relied-Upon Prior Art Based Rejections</u>

<u>Eberhard, McGrow, and Williams</u>

Claims 1 – 2, 4 – 8, 10 – 16, 22, 24-28, 33, 35-37, 41, 44, 45- 48, 51-55, 58, 67-70, 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5019267 to Eberhard in view of USP 5213693 to McGrow (incorporating 5178774 to Payne) and USP 5561520 to Willliams.

USP 5019267 to Eberhard describes a method for dewatering biological sludge from a digestion process. Applicant agrees that Eberhard describes dewatering of a biological sludge from a thermophilic digestion process using inter alia a cationic

polyacrylamide.[3] Specifically, Eberhard describes heating the biological sludge to 75°C (Example 3, claim 8) then adding a cationic polymeric flocculent ZETAG 92 (Eberhard at col 5 line 58). ZETAG 92 is an ultra-high molecular weight polyacrylamide carrying a medium charge density (USP 5561520 to Willliams, at col 6 line 10). Accordingly, Eberhard describes a method for dewatering biological sludge from a thermophilic digestion process comprising the step of adding to the thermophilic biological sludge a cationic polyacrylamide such that the polyacrylamide enhances dewatering of the sludge. Eberhard does not describe the addition of a polymeric quaternary ammonium compound, as primary component, to the biological sludge.

USP 5213693 to McGrow describes a method of facilitating the dewatering of an aqueous suspension, e.g., sewage sludge, by adding a low molecular weight poly(DADMAC)(col 4line 37) (or polyamine made by condensation of epichlorohydrin with an amine) (col 4 line 29) coagulant solution along with, i.e., simultaneously with, a high molecular weight cationic polyacrylamide flocculent solution (col 5 line 55). McGrow teaches that use of the poly(DADMAC) or poly(epichlorohydrin-amine) in addition to the cationic polyacrylamide offers numerous advantages over the traditional methods of using the high molecular weight cationic polymeric flocculent alone (col 6 line 30). The advantages include flocs that are small, evenly structured, highly filterable, having good shear stability, and a system that is relatively resistant to underdosing and overdosing. Accordingly, prior art problems of gelatinous flocs, disadvantageous coring, and reduced productivity experienced when the high molecular

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[3] Applicant's 7/6/09 Response at page 16 and 11/3/08 Response, at page 40 of 44, line 7.

weight cationic polymeric flocculent was used alone can be avoided. Higher cake dry solids result due to the better floc structure. Overall, the McGrow dewatering process gives reduced cycle time, drier cake, better filter or belt press capacity utilization, improved filtrate quality, better cake release from the filter cloth, and cleaner filter cloths (col 6 lines 30-45).

For any combination of the aforementioned advantages, it would have been obvious to the person having ordinary skill in this art to have used a combination of poly(DADMAC) coagulant, e.g., Percol 368, and high molecular weight cationic polyacrylamide flocculent, e.g., PERCOL 757, in place of Eberhard's use of ZETAG 92 alone. USP 4396513 shows that PERCOL 757 is a cationic polyacrylamide.

Per claim 5, McGrow teaches that the weight ratio of coagulant to flocculent be in the range 0.7 – 2 (col 5 line 63). A ratio of 0.7 is "approximately 1:1." Alternatively, a weight ratio of 1:1 would have been obvious given the teaching of 0.7 – 2.

Per claims 6, 27 McGrow teaches that the weight ratio of coagulant to flocculent of 0.1 (col 5 line 59). This ratio is the same as a polymeric quaternary ammonium compound : cationic polyacrylamide weight ratio of 1:1.

Per claims 7 and 28, the dosage of polymer added per percent total solids in the sludge is a matter of routine experimentation, so optimization of the same would have been prima facie obvious. Besides, McGrow's example of "about 4 kg per ton dry solids sludge" (col 7 line 50) corresponds to about 44 ppm:1% solids.[4] Claim-recited "about 50 ppm : 1% " reads on about 44 ppm:1% solids, as described by McGrow.

[4] Assume one ton (2000 lb) dry solids suspended in a 1% solids suspension with 4 kg added polymer.

Furthermore, the range of about 44 ppm: 1% solids to about 55 ppm: 1% solids is suggested by McGrow's comparison test using 4 - 5 kg polymer (col 7 line 59) so that true side-by-side comparisons can be made.

Per claim 8, McGrow states that coagulant beads can be added directly to the suspension followed by addition of an anionic flocculent. McGrow col 4 lines 4 - 13.

Per claims 10 and 12, McGrow describes using 10 parts coagulant polymer for each part flocculant polymer (col 5 lines 56-63, especially line 61). Alternatively, per claims 12 and 13, it would have been obvious to have optimized the relative proportion of the coagulant and flocculant because this process parameter is well-known to be result- effective in flocculation processing.

Per claim 11, see col 9 lines 7 - 41, particularly lines 10 - 11, as well as col 6 line 55 of USP 5178774 to Payne (incorporated by reference into McGrow). Payne teaches using anionic flocculants that are at least 50% anionic. Applicant / owner's claim-recited limitation that the anionic polyacrylamide be "about 40% anionic" reads on Payne's description of the anionic polyacrylamide flocculant that is 50% anionic. Alternatively, it would have been obvious to have varied the mol % of the charged (anionic) monomer in the flocculant copolymer to optimize dewatering performance because percent charge is a known result-effective variable, as shown by McGrow and Payne.

Per claim 14, McGrow[5] suggests treating a biological sludge mixed with a primary sludge.

[5] McGrow describes conditioning of a “digested primary/activated/humus sludge.”

Per claim 22 and claim 33, as set forth above, Eberhard as modified by McGrow describes a method for dewatering a sludge comprising thermophiles in which the sludge is contacted by a polymeric quaternary ammonium compound, i.e., poly(DADMAC), along with a cationic polyacrylamide. The two compounds meet the molecular weight limitations of claim 24. McGrow describes the compounds functioning in the manner set forth in claim 25.

<u>Eberhard, McGrow, and Sak</u>

Claim 14 is rejected under 35 USC Sec. 103(a) over Eberhard, McGrow, Payne and Willliams, as applied to claim 1 above, further in view of USP 3397139 to Sak. Sak teaches it was conventional to dewater combined primary and secondary sludges. Accordingly, it would have been obvious to have mixed Eberhard's sludge with primary sludge before thermophilic sludge treatment of the same, as suggested by Sak.

<u>Eberhard, McGrow, Willliams, and Coscia, Tanaka, or Neff</u>

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Eberhard, McGrow, Payne and Willliams, as applied to claim 1 above, further in view of USP 4137165 to Coscia, USP 4155847 to Tanaka, or USP 5405554 to Neff.

McGrow describes using a polyamine made from the condensation of epichlorohydrin and an amine, but does not specifically describe poly(epichlorohydrin-dimethyl amine). It would have been obvious to have selected poly(epi-DMA) for use as the polyamine taught by McGrow because Coscia teaches that poly(epi-DMA) is an

available polyamine known for use as a polymeric flocculent, because Tanaka teaches that the polycondensate of epichlorohydrin and dimethylamine is a commercially sold sewage dewatering flocculent product (col 8, Table footnote, Sample D), or because Neff teaches that preferred low molecular weight sludge dewatering cationic polyamine is poly(epi-DMA) (col 6).

Eberhard and Payne

Claims 33, 35, 38, and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5019267 to Eberhard and McGrow, as applied to claim 33 above, further in view of USP 5178774 to Payne.

USP 5019267 to Eberhard describes a method for dewatering biological sludge from a digestion process. Eberhard describe heating the biological sludge to 75°C (Example 3, claim 8) then adding a cationic polymeric flocculent ZETAG 92 (Eberhard at col 5 line 58). Eberhard does not describe the addition to the sludge of a polymeric quaternary ammonium compound.

McGrow suggests substituting simultaneous addition of cationic polyDADMAC coagulant and cationic polyacrylamide flocculent for the prior art addition of cationic polyacrylamide flocculent alone. McGrow, including the Payne portion thereof, suggests substitution of addition of cationic polyDADMAC (a quarternary ammonium compound) coagulant (Payne, col 7 line 35, col 8 line 3) followed by an anionic high molecular weight polyacrylamide flocculent (col 9 lines 30 – 32) in place of Eberhard's cationic polyacrylamide alone.

The proportions recited in claim 40 are suggested by McGrow or the result of routine experimentation because dose is a known result-effective variable in the sludge conditioning art.

<u>Response to Audrey Hasse Declaration Filed 3/22/11</u>

Declarant appears to take the position she does not believe McGrow motivated a person having ordinary skill in the art at the time the invention was made to have used a polyquaternary amine to enhance dewatering of a biological sludge from a thermophilic process primarily because McGrow is allegedly concerned about problems or challenges associated with over-dosing, e.g., gelatin formation and coring formation, whereas , in Declarant's view, these ore not problems encountered in thermophilic processes.

The Examiner does not find this opinion evidence persuasive of patentability primarily because the particular reason the prior art may have described a technology, i.e., use of quaternary amine compounds to address over-dosing related issues, need not be the same problem faced by applicant at the time the invention was made. It is sufficient, in this case, that the prior art describes the use of the same sludge conditioning compounds for the same problem: Dewatering of a biological sludge. Applicant / owner should recall that McGrow does not explicitly state that the biological digested sludge was digested by a mesophilic process. McGrow is silent as to whether the sludge was digested by a mesophilic or a thermophilic digestion process.

Response to Applicant's Other Arguments

Applicant's claims do not exclude the addition to the sludge of materials that are not recited in applicant's claims. Therefore, even if Eberhard described the addition of materials, e.g., enzyme and chelant, such additions do not negate the fact that Eberhard describes dewatering of a biological sludge from a thermophilic digestion process using a cationic polyacrylamide. Insofar as Applicant's claimed method is not limited to the addition to the thermophilic biological sludge of only a polymeric quaternary ammonium compound and the particular claimed-specified polyacrylamide, Eberhard's addition of other materials is not a teaching away of the claimed invention.

Even if McGrow teaches that addition of cationic polyacrylamide alone is sufficient to reduce treatment costs, such observation does not constitute a teaching away of use of cationic polyacrylamide in combination with poly(DADMAC)(col 4line 37) (or polyamine made by condensation of epichlorohydrin with an amine) (col 4 line 29) coagulant solution. The straightforward reason is that McGrow describes the use of both polyacrylamide and poly(DADMAC) (or polyamine). If a reference teaches "X," the reference clearly does not "teach away" from "X."

The fact that Dental et al. and/or Chitikela et al. used one approach does not dilute the teachings of others working in the field, e.g., Eberhard and McGrow.

Applicant's argument (Response 7/6/09 at page 24) that the claimed invention was not obvious in Sept. 1990 is inapposite for the relevant time period is "at the time the [applicant's] invention was made." Insofar as the Prakasam (EPA Project Summary) report of Sept 1990 antedated the publication of the prior art relied upon by

the examiner, i.e., Eberhard and McGrow, its teachings – whatever they might be - are of limited relevance for they do not represent the state of the art at the relevant time period.

With respect to applicant's argument that no essential step is missing from claim 33, the examiner adds that the specification refers to the polyquaternary amine as the "primary component" to form microflocs. It would have been clear to the person having ordinary skill in this art that applicant believed that a "bridging" compound, e.g., polyacrylamide, was required to effectively dewater the sludge. It is noted that no working (or prophetic) example uses polyquaternary amine alone without also using a polyacrylamide to effect acceptable dewatering performance.

/Chester T. Barry/
Primary Examiner, Art Unit 1778
571-272-1152